

ISP203A – Global Change
Convection in the Asthenosphere and Ocean Circulation

GROUP #: 1A
Student IDs of Members Present:
A42 A41919545
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Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	gravitational
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	chemical
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Denser water sinks	Gravitational
Cold, denser material sinks	Dense water sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar energy heats ocean water at the equator	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	wind currents move masses of water	Gravitational
Oceanic lithosphere slowly cools	Water cools as it moves towards the poles	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

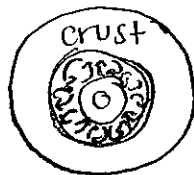
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Heat from the core (Radioactive)	Solar Energy
Density differences	Less dense material in mantle rises.	More dense water in ocean sinks.

1. Explain why density is such an important concept for asthenosphere convection.

Without a difference in density, convection would not exist because density is the driving force within the asthenosphere.

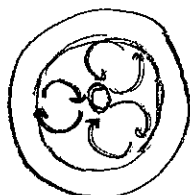
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

Because denser material would then be drawn toward the crust, the crust itself would be considerably thicker and convection in the asthenosphere would be reduced.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

Convection would be larger due to the decreased size of the new core that was created by the denser crust.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal
Mixing of cold bottom waters with warm surface waters	Thermal / Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	denser material sinks	Gravitational
Cold, denser material sinks	denser material sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	sun rays heat ocean surface	Thermal
Sinking lithosphere pulls the plate toward the subduction zone		Gravitational
Oceanic lithosphere slowly cools	denser water cools as it sinks	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

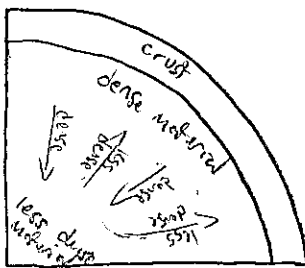
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	radioactive decay & residual heat	sun rays
Density differences	solid material Heat pressure	Heat & salt content

1. Explain why density is such an important concept for asthenosphere convection.

The density of the material in the asthenosphere determines whether the material will sink to the bottom or rise.

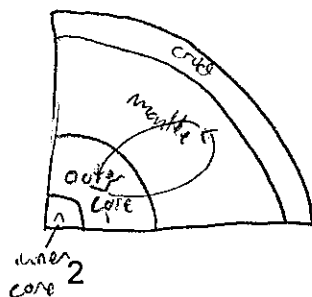
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



dense material would gather near to the crust where pressure would then be greatest and it would lose heat out to space. The least dense material would gather nearer to the center.

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

The outer core would be moving closer to the surface.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	chemical/thermal
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

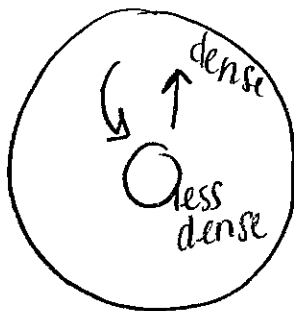
Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Denser material sinks.	Gravitational
Cold, denser material sinks	Cold water sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar Radiation heating equator	thermal
Sinking lithosphere pulls the plate toward the subduction zone		Gravitational
Oceanic lithosphere slowly cools		thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

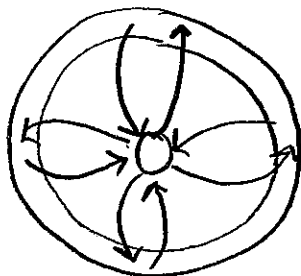
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational	thermal
Density differences	temperature & composition	temperature & salinity

1. Explain why density is such an important concept for asthenosphere convection.
because it's the reason why convection works in the asthenosphere
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



less dense material would go towards the center
While more dense would go toward the outside

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



ISP203A – Global Change
Convection in the Asthenosphere and Ocean Circulation

GROUP #: 4

Student IDs of Members Present:

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Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Mixing of cold bottom waters w/ warm surface waters	Gravitational
Cold, denser material sinks	Dense water sinks in the North Atlantic Ocean	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than poles	Chemical / Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of water toward the poles	Gravitational
Oceanic lithosphere slowly cools	→	Gravitational

Consider how ~~these two systems~~ are different. In the table below, fill in the differences between the asthenosphere and oceans.

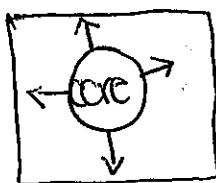
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Thermal	Gravitational
Density differences	between metals.	between salt and fresh water

1. Explain why density is such an important concept for asthenosphere convection.

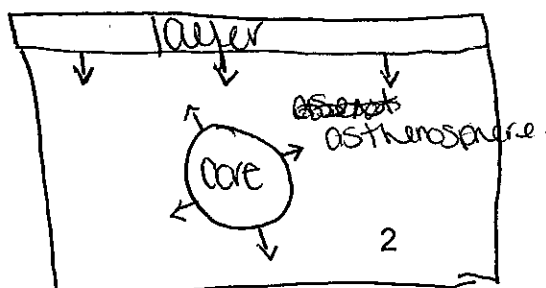
Density is important because the difference in density between the metals that compose the asthenosphere is what causes the convection.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



No Subduction
Core slowly expanding

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	gravitational
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	gravitational
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	more dense material sinks because of gravity	gravitational
Cold, denser material sinks	same →	gravitational
Radioactive decay and residual heat from deep within Earth	wind & solar energy	thermal
Sinking lithosphere pulls the plate toward the subduction zone	cold water subducts beneath warm water pulling warm water up	gravitational
Oceanic lithosphere slowly cools	water cools the deeper it is	thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

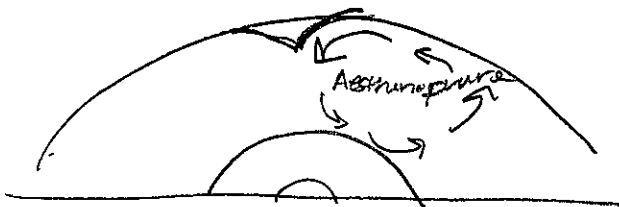
Difference	Asthenosphere	Oceans
Primary source of energy for movement	radio active decay residual heat	solar & wind energy
Density differences	less dense = rise	more dense = sink

1. Explain why density is such an important concept for asthenosphere convection.

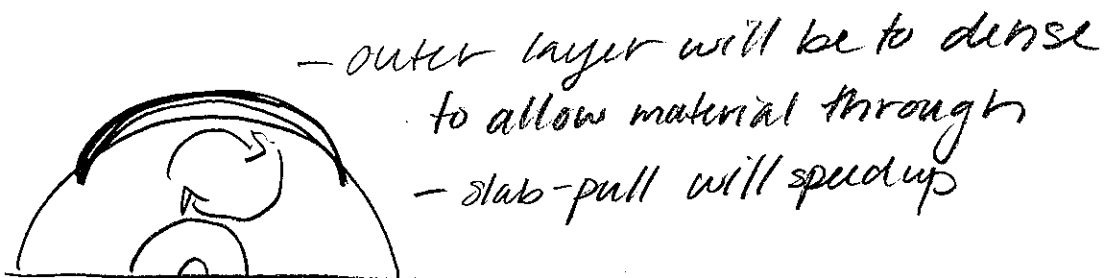
Density is important for the asthenosphere because it keeps materials flowing because less dense materials rise & colder denser materials sink, this keeps the plates moving.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

less dense materials sink & cold dense materials will rise



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



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Part 2: Group Work

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Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
✓ Wind-driven currents move masses of water toward the poles	Grav.
Mixing of cold bottom waters with warm surface waters	Grav.
✓ Solar radiation is more intense at the equator than the poles	Therm.
Water becomes saltier through evaporation	Chem.
✓ Dense water sinks in the North Atlantic Ocean	Grav.

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Dense H ₂ O sinks in N. Atlantic Ocean	Grav.
Cold, denser material sinks	Dense H ₂ O sinks in N. Atlantic Ocean	Grav.
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense @ the equator than poles	Therm.
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of H ₂ O toward the poles	Grav.
Oceanic lithosphere slowly cools	NO MATCHES.	

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

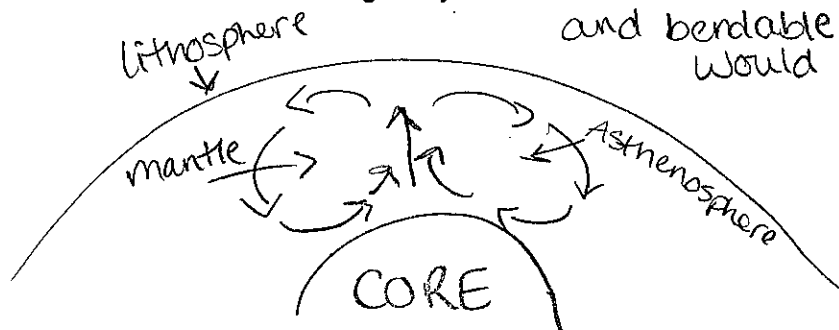
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational	Gravitational
Density differences	Less dense material rises because of gravity	More dense material sinks because of gravity

1. Explain why density is such an important concept for asthenosphere convection.

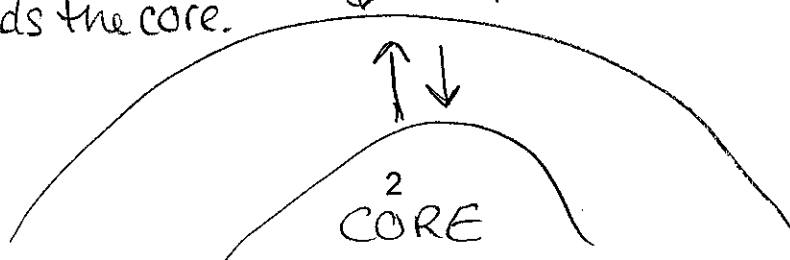
If the less dense material didn't rise then that material would sink to the core along with everything else.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world. Earth's surface would be hot and bendable and the core would be solid



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

Convection would stop because material would be too dense to rise, all of the less ^{dense} material would be towards the core.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Mixing of cold bottom waters with warm surface	Gravitational
Cold, denser material sinks	Dense water sinks in North Atlantic	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at equator than pole	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind driven currents move masses of water toward the poles	Gravitational
Oceanic lithosphere slowly cools	Solar radiation is more intense at equator than poles	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

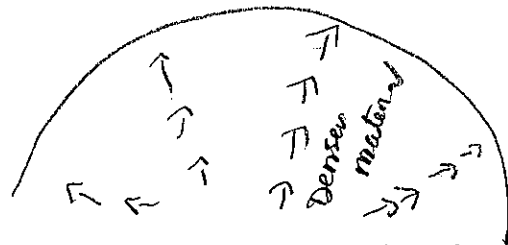
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Temperature Convection	Wind currents + density
Density differences	Less dense material rises because of gravity. Heat source: core	Less dense liquid rises due to temp Heat source: surface

1. Explain why density is such an important concept for asthenosphere convection.

Density drives the circulation through the
asthenosphere.

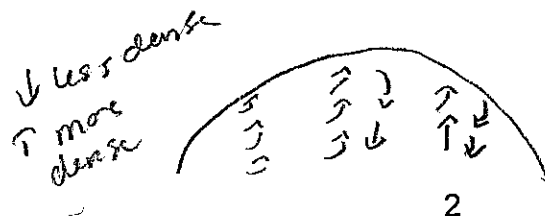
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

Everything would just
be a solid mass
at the surface.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

The dense stuff would go to the outside



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Denser materials sink	Gravitational
Cold, denser material sinks	Dense water sinks in the North Atlantic Ocean	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than at the poles	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Denser material will sink toward the ocean floor	Gravitational
Oceanic lithosphere slowly cools	With wind, the waters slowly cool	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

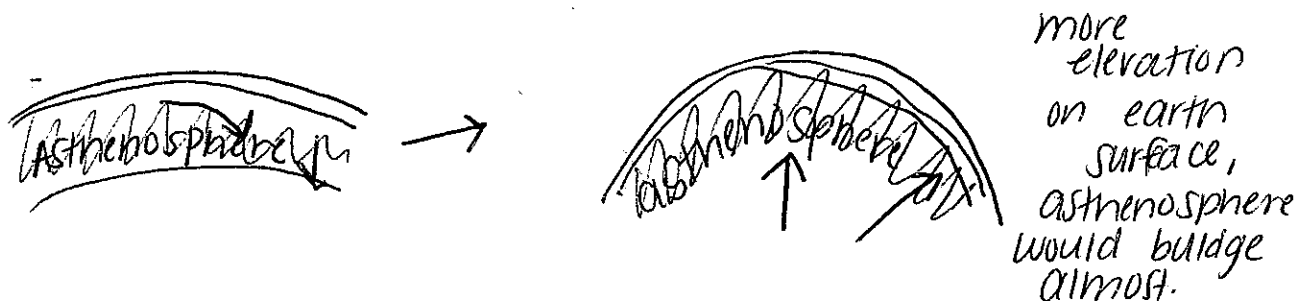
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	pressure + composition	Wind
Density differences	less dense materials rise	The more dense materials sink

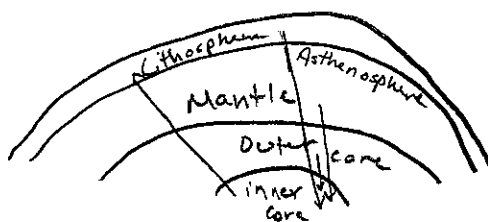
1. Explain why density is such an important concept for asthenosphere convection.

Density causes materials to rise and sink in the asthenosphere so with no density all of the materials would cluster together.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



The asthenosphere would sink because it is less dense than the core so essentially the outer layers would become inner layers & vice versa.

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	cold water sinks because of gravity	Gravitational
Cold, denser material sinks	Cold denser water sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind driven currents move masses toward poles	Gravitational
Oceanic lithosphere slowly cools	Warm less dense water cools	Gravitational

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

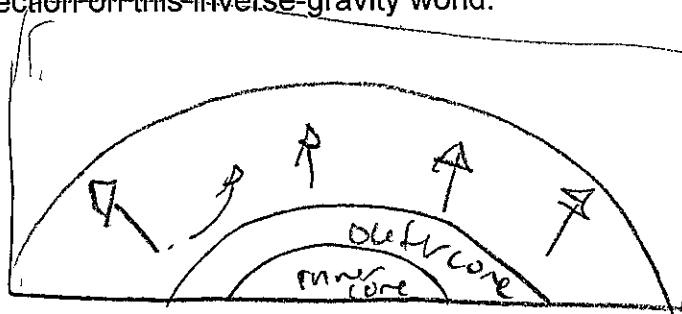
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational/ Thermal	Gravitational/ Thermal
Density differences	Cooler toward crust warmer near core also pressure.	Salt warm/cool water

1. Explain why density is such an important concept for asthenosphere convection.

Density is important because it helps drive it as parts of it cool & sink & others heat up & rise.

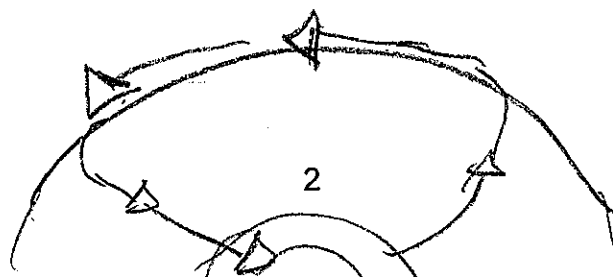
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



The asthenosphere would convect because more dense material would stay at the crust & never heat up being gravity.

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

The outer layers would sink & inner layers rise.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	
Mixing of cold bottom waters with warm surface waters	
Solar radiation is more intense at the equator than the poles	
Water becomes saltier through evaporation	
Dense water sinks in the North Atlantic Ocean	

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity		
Cold, denser material sinks		
Radioactive decay and residual heat from deep within Earth		
Sinking lithosphere pulls the plate toward the subduction zone		
Oceanic lithosphere slowly cools		

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Convection in the Asthenosphere and Ocean Circulation

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement		
Density differences		

1. Explain why density is such an important concept for asthenosphere convection.
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.
3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	gravitational
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	thermal
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	dense water sinks in the North Atlantic	gravitational
Cold, denser material sinks	mixing of cold bottom waters w/ warm surface waters	gravitational
Radioactive decay and residual heat from deep within Earth	solar radiation is more intense at the equator than the poles	thermal
Sinking lithosphere pulls the plate toward the subduction zone	wind-driven currents move masses of water toward the poles	gravitational
Oceanic lithosphere slowly cools	water becomes saltier through evaporation	thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

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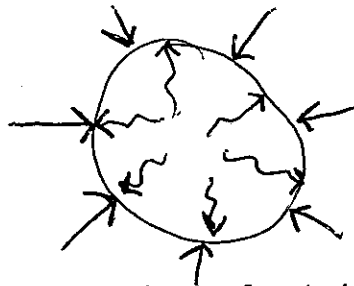
Difference	Asthenosphere	Oceans
Primary source of energy for movement	gravitational	thermal
Density differences	gravitational thermal	thermal

1. Explain why density is such an important concept for asthenosphere convection.

The more dense the mantle is then the less heat will be released from the asthenosphere

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

It would make it more difficult for heat to escape



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

Heat would move quickly out of the Earth's middle layers but would have trouble escaping through the outermost layer

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational, Thermal
Mixing of cold bottom waters with warm surface waters	Thermal
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	saltier water sinks because of gravity, its more dense	Gravitational
Cold, denser material sinks	Cold water is more dense and sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	Heat from inside Earth heats ocean water through vents	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Movement driven by density, gravity	Gravitational
Oceanic lithosphere slowly cools		Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

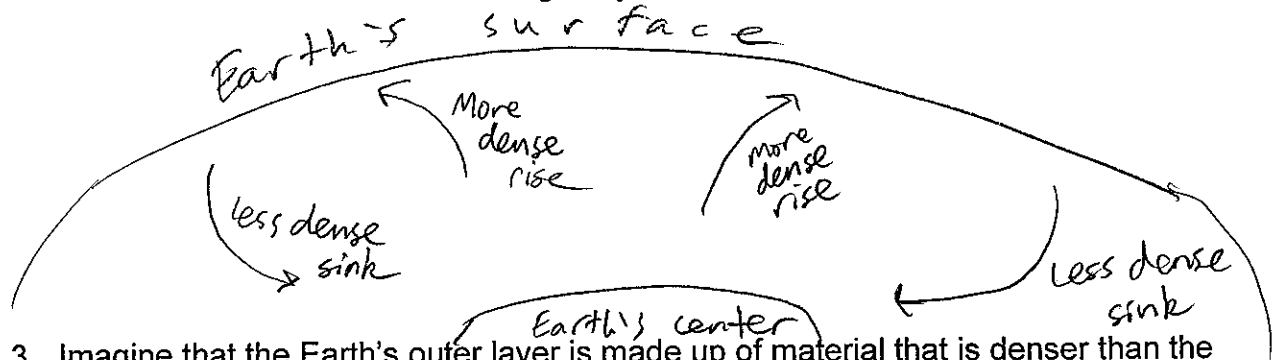
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational	Thermal
Density differences	Solid composition	Liquid composition

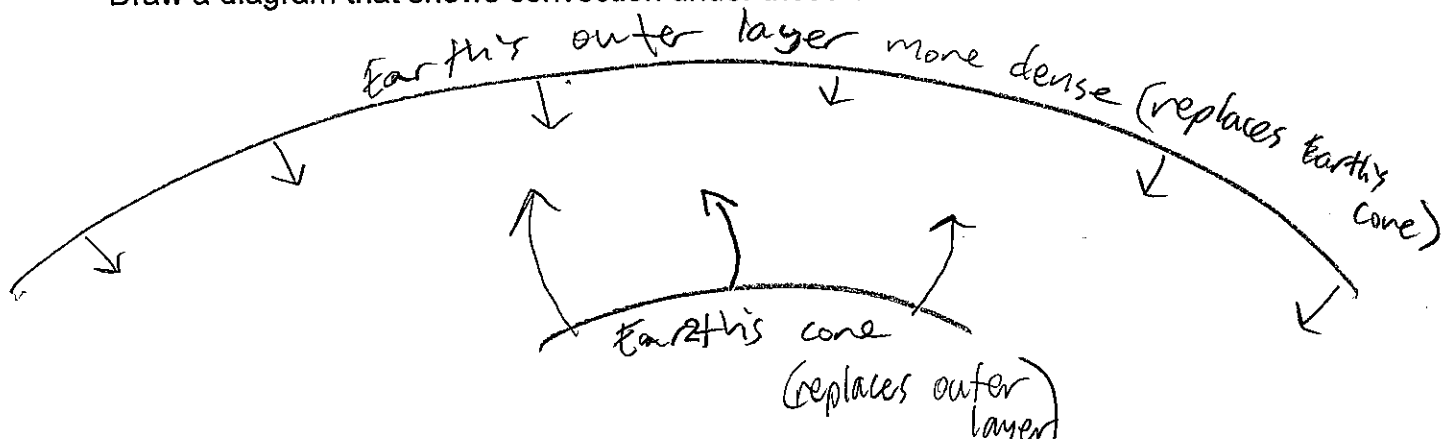
1. Explain why density is such an important concept for asthenosphere convection.

More dense matter in the mantle will sink to the bottom while the less dense matter will rise

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

GROUP #:
Student IDs of Members Present:

██████████ 472096024

██████████ 443819247

██████████ 442957208

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	Gravitational
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Dense water sinks in N. Atlantic ocean	Gravitational
Cold, denser material sinks	Dense water sinks in N. Atlantic Ocean	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than the poles	thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of water towards the poles	Gravitational
Oceanic lithosphere slowly cools	Mixing of cold bottom waters w/ cold surface waters	Gravitational

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

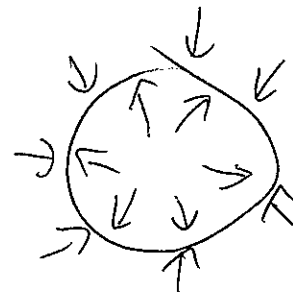
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational pull on objects with varying density	Primary Density differences & temperature with gravitational pull.
Density differences	more dense	less dense

1. Explain why density is such an important concept for asthenosphere convection.

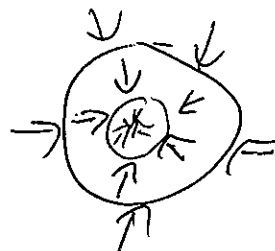
Without differences in density, there would be equal gravitational pull resulting in no circulation.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

The more dense things would be pulled to the surface & not the core



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

GROUP #: 14
Student IDs of Members Present:

A39222014
A43376720
A43219269

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Dense water sinks in the N. Atlantic Ocean	Gravitational
Cold, denser material sinks	Mixing of cold bottom waters w/ warm surface waters	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than the poles	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of water toward the poles	
Oceanic lithosphere slowly cools		

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

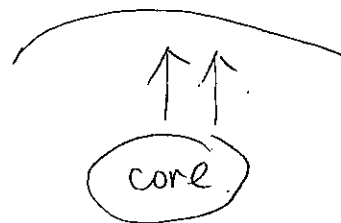
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational	Gravitational Thermal
Density differences	less dense objects rise	more dense objects sink

1. Explain why density is such an important concept for asthenosphere convection.

It allows for plate movement. The greater density of old lithosphere relative to the underlying asthenosphere allows it to sink into deep mantle at subduction zones.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

It would make everything on the surface more dense



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

Convection would pull everything toward the core to make it more dense.
The material with higher density will sink.

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	thermal; maybe gravitational
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	chemical
Dense water sinks in the North Atlantic Ocean	grav.

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	less dense water rises (cooler) not dense sinks	gravitational
Cold, denser material sinks	cold denser water sinks	gravitational
Radioactive decay and residual heat from deep within Earth	N/A	thermal (drives differences in temperature); chemical
Sinking lithosphere pulls the plate toward the subduction zone	ocean circulation	gravitational
Oceanic lithosphere slowly cools		Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

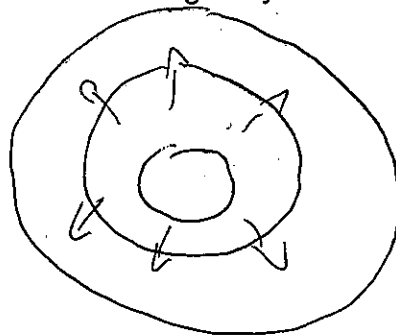
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	<ul style="list-style-type: none"> • composition • temperature change 	<ul style="list-style-type: none"> • composition • temperature change
Density differences	DENSITY DIFFERENCES BETWEEN DIFFERENT MATERIALS	DENSITY DIFFERENCES BETWEEN WATER (SALINITY, Temp)

1. Explain why density is such an important concept for asthenosphere convection.

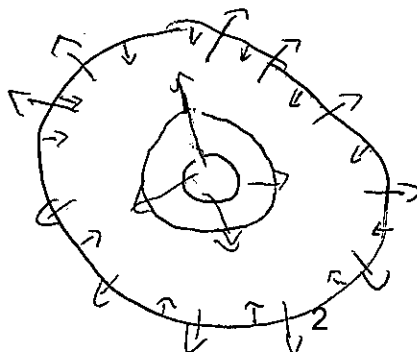
Determines which material rises/sinks

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



Denser material would move towards the surface

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



ISP203A – Global Change
Convection in the Asthenosphere and Ocean Circulation

Part 2: Group Work




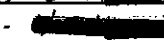

GROUP #: 
Student IDs of Members Present:
43145662 - 
40974799 - 
37497963 - 
41944159 - 

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Thermal
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

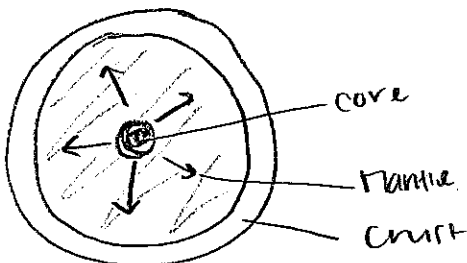
Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Water becomes saltier through evaporation	gravitational
Cold, denser material sinks	Dense water sinks	gravitational
Radioactive decay and residual heat from deep within Earth		thermal
Sinking lithosphere pulls the plate toward the subduction zone		gravitational
Oceanic lithosphere slowly cools		thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

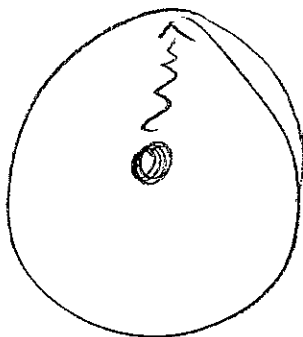
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	gravitational	thermal
Density differences	gravitational / thermal	thermal

1. Explain why density is such an important concept for asthenosphere convection.
The more dense plate subducts beneath the less dense plate.
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



The Core would move to the earth's surface if convection continued to occur.

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Thermal
Dense water sinks in the North Atlantic Ocean	Gravitational

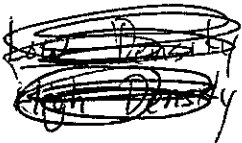
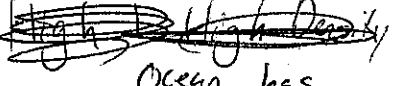
Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Wind driven Wind driven currents move masses of water toward the poles	Gravitational
Cold, denser material sinks	Mixing of cold bottom waters w/ warm surface waters	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at equator than poles	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Dense water sinks in the North Atlantic Ocean	Gravitational
Oceanic lithosphere slowly cools	Water becomes saltier through evaporation	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

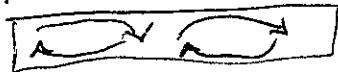
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Thermal radiation from core core	Thermal from Sun
Density differences	 Asthenosphere is generally lower density	 Ocean has higher density

1. Explain why density is such an important concept for asthenosphere convection.

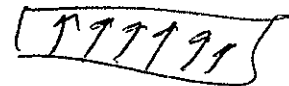
Density is what drives the movement ~~of~~ within the asthenosphere. Density, along with temperature, drives the up and down/circulation within the asthenosphere.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

Instead of actual circulation



The heat would just go straight to the top and reg



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

With more dense material on top, convection would continue. ^{at the same pace} The more dense outer layer would sink to the bottom, and the less dense center would rise to the top. Eventually Earth would return to its present state.

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	GRAVITATIONAL
Mixing of cold bottom waters with warm surface waters	Thermal
Solar radiation is more intense at the equator than the poles	Chemical / Thermal
Water becomes saltier through evaporation	Thermal
Dense water sinks in the North Atlantic Ocean	Thermal / GRAVITATIONAL

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	BOUANCY / DENSE MATERIAL SINKS	GRAVITATIONAL
Cold, denser material sinks	CONVECTION / CURRENT	GRAV / THERMAL
Radioactive decay and residual heat from deep within Earth	HEAT FROM SUN	CHEMICAL / THERMAL
Sinking lithosphere pulls the plate toward the subduction zone	GRAVITATION SINK OF DENSE WATER	GRAVITATIONAL
Oceanic lithosphere slowly cools	WATER COOLS AT POLES	THERMAL

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

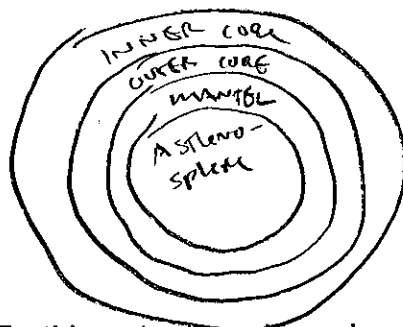
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Thermal & compositional	Thermal & gravitational
Density differences	CAUSED by pressure	CAUSED by Temp & salinity

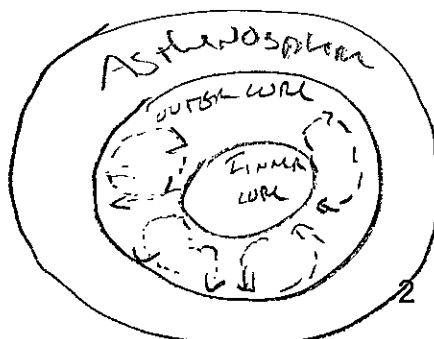
1. Explain why density is such an important concept for asthenosphere convection.

BOUANCY CAUSES MATERIAL TO RISE & FALL BASED ON RELATIVE DENSITY. THIS CAUSES CONVECTION IN THE MANTLE

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	GRAVITATIONAL.
Mixing of cold bottom waters with warm surface waters	GRAVITATIONAL.
Solar radiation is more intense at the equator than the poles	THERMAL.
Water becomes saltier through evaporation	CHEMICAL.
Dense water sinks in the North Atlantic Ocean	GRAVITATIONAL.

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

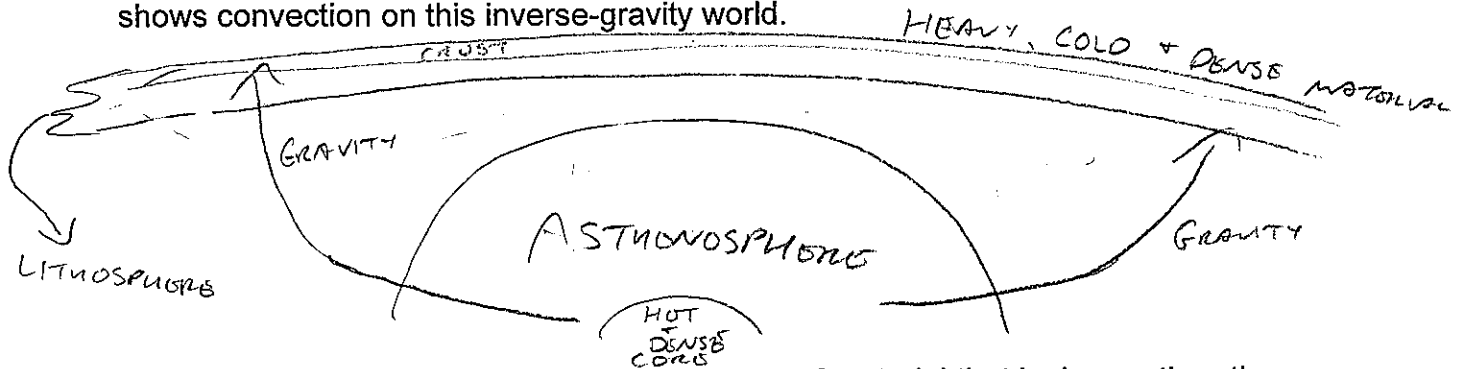
Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	DENSER MATERIAL SINKS.	GRAVITATIONAL.
Cold, denser material sinks	COLDER, SALTIER, DENSER WATER SINKS.	GRAVITATIONAL.
Radioactive decay and residual heat from deep within Earth	SOLAR RADIATION ON EQUATOR CIRCULATES OCEANS.	THERMAL.
Sinking lithosphere pulls the plate toward the subduction zone	SINKING COLD WATER REPLACED BY WARMER WATER.	GRAVITATIONAL.
Oceanic lithosphere slowly cools	WARM WATER AT POLES COOLS.	THERMAL.

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

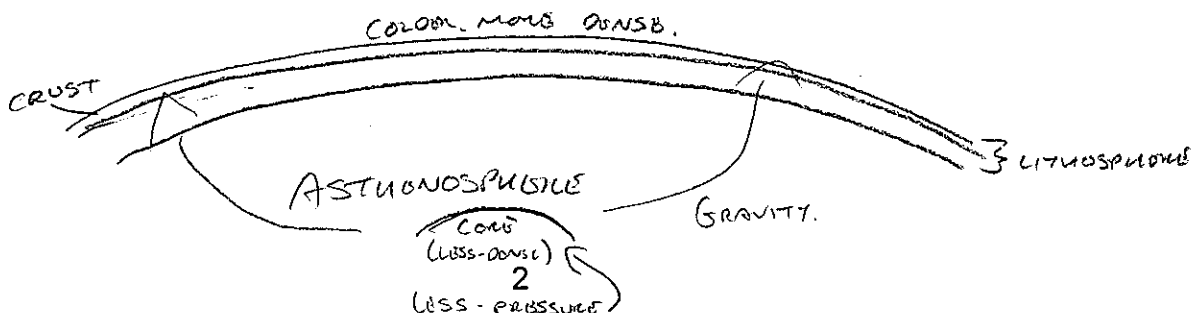
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	<ul style="list-style-type: none"> RADIOACTIVE DECAY CORE RADIATION + HEAT DENSITY 	<ul style="list-style-type: none"> SOLAR RADIATION WIND CURRENTS
Density differences	<ul style="list-style-type: none"> PRESSURE TEMPERATURE + MINERAL CONTENT IRON, ETC. 	COLDER, DENSER ^{SALTIER} OCEAN WATER SINKS TO BOTTOM OF OCEAN. WARMER WATER RISES TO SURFACE + IS MOVED BY WIND CURRENTS TOWARDS POLES + AWAY FROM EQUATOR.

- Explain why density is such an important concept for asthenosphere convection.
 • IMPORTANT BECAUSE IT IS RESPONSIBLE FOR CONVECTION MOVEMENT.
 DENSE MATERIAL SINKS + LESS-DENSE MATERIAL RISES.
- What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



- Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Thermal
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	dense material sinks	Gravitational
Cold, denser material sinks	dense water sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	solar radiation is more intense at the equator	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	dense water gets pulled towards the poles	Gravitational
Oceanic lithosphere slowly cools	dense water sinks	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

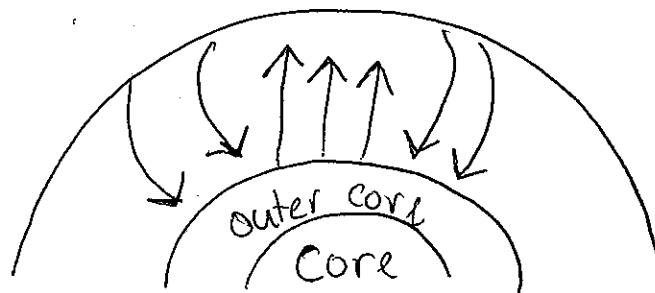
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	thermal	gravitational
Density differences	temperature, pressure	temperature and composition

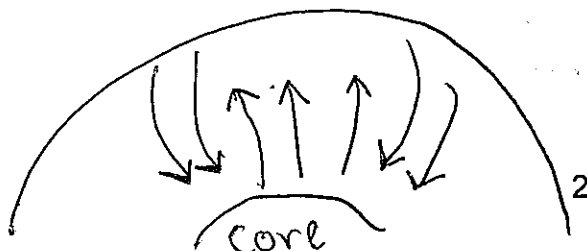
1. Explain why density is such an important concept for asthenosphere convection.

Density determines different shifts of convection in the asthenosphere

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal
Mixing of cold bottom waters with warm surface waters	Gravitational - Thermal
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	less dense material rises	Gravitational / Thermal
Cold, denser material sinks	Cold dense water sinks	Gravitational / Thermal
Radioactive decay and residual heat from deep within Earth	Solar radiation more intense at equator	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	thermohaline	Gravitational / Thermal
Oceanic lithosphere slowly cools	Thermohaline circulation from poles	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	residual heat and radioactive decay	solar radiation
Density differences	slab pull Thermal chemical	Thermal

1. Explain why density is such an important concept for asthenosphere convection.

Convection in the asthenosphere causes movement in the crust

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

Then less dense material would sink. The more dense material would rise

surface

more dense
less dense

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

It would be like the movie 2012.
Earthquakes and volcanoes

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal Gravitational
Mixing of cold bottom waters with warm surface waters	Chemical Thermal
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

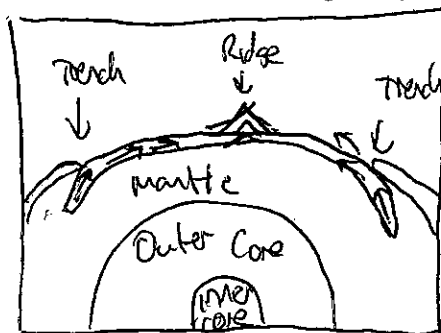
Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Materials rise because of density dense material sink	Gravitational
Cold, denser material sinks	Cold denser material also sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than the poles	Thermal (drives diff in temp)
Sinking lithosphere pulls the plate toward the subduction zone	Wind driven currents move masses of water toward the poles	Gravitational
Oceanic lithosphere slowly cools	Mixing of cold bottom waters w/ warm surface waters	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

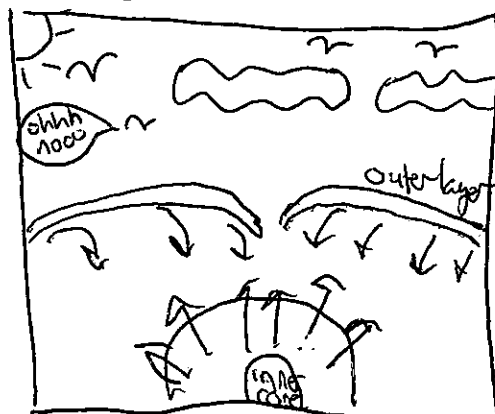
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Earth's Core (thermal)	Solar radiation
Density differences	More dense composition & pressure	Denser heat More dense composition sinks

1. Explain why density is such an important concept for asthenosphere convection.
Matter moves & changes to return a system to equilibrium. The density determines if it rises or sinks.
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Disaster

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	gravity
Mixing of cold bottom waters with warm surface waters	thermal grav.
Solar radiation is more intense at the equator than the poles	thermal / chemical
Water becomes saltier through evaporation	thermal / chemical
Dense water sinks in the North Atlantic Ocean	gravity

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation.

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	denser material SINKS	gravitational
Cold, denser material sinks	cold, denser salt water SINKS	gravitational
Radioactive decay and residual heat from deep within Earth	cold water deep within the ocean	thermal
Sinking lithosphere pulls the plate toward the subduction zone	warm water circulates to poles	gravitational
Oceanic lithosphere slowly cools	co warm water warms poles	thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

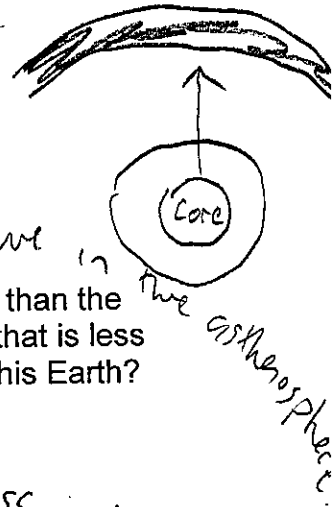
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Thermal/ gravitational	Thermal/ gravitational
Density differences	less & more dense/differing compositions of earth	Salt vs Fresh water

1. Explain why density is such an important concept for asthenosphere convection.

density allows for circulation in the mantle.

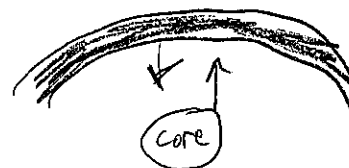
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

the core would be pulled to the earth's surface and cause it to warm. The convection cycle would be shortened because there is increased pressure in the asthenosphere.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

The surface would sink into the less dense asthenosphere and the core would rise because it is less dense.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	gravitational
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	chemical
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Warm water (less dense) rises to the top, cold & saltier sinks down	gravitational
Cold, denser material sinks	cold, denser material sinks.	gravitational
Radioactive decay and residual heat from deep within Earth	solar radiation	thermal
Sinking lithosphere pulls the plate toward the subduction zone	—	gravitational
Oceanic lithosphere slowly cools		thermal

ISP203A – Global Change
Convection in the Asthenosphere and Ocean Circulation

A40208496

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	pressure	wind
Density differences	denser → more pressure sinks less dense - goes up	cold saltier sink warm less saltier on the surface.

hot & cold water circulates

1. Explain why density is such an important concept for asthenosphere convection.
density is vital for hot, cold, more molecule matters to circulate. ~~Hot~~ denser materials sink & less dense materials rise.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



Earth would have more rocks, heavier denser rocks.

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Earth layer - most dense
Asthenosphere - medium
core - least dense

2

asthenosphere becomes the earth's ~~outer~~ layer.
The convection flows outer layer at it - earth is now the asthenosphere

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Thermal
Mixing of cold bottom waters with warm surface waters	Thermal, Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Mixing of cold bottom waters with warm surface waters	Gravitational
Cold, denser material sinks	Dense water sinks in the North Atlantic Ocean	Thermal, Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than the poles	Thermal, Chemical
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of water toward the poles	Gravitational
Oceanic lithosphere slowly cools	Water becomes saltier through evaporation	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

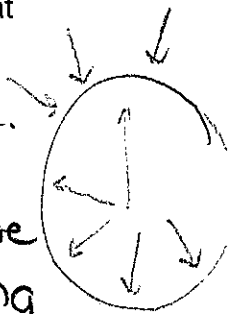
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational	Temperature
Density differences	Composition	Temperature

1. Explain why density is such an important concept for asthenosphere convection.

It creates the current that moves the matter, allows asthenosphere to bend and plates to move

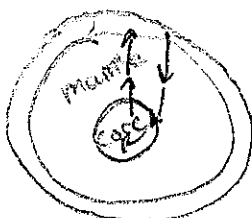
2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

The Earth's surface would be much more dense. We would also have more mountains because material would be pushed up. Also there would be less gravity because there would be less pulling down. This would create question 3, having the core "sink" towards



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions. It would be eliminating continents into iron!

Create a pressure gradient with the outermost layer wanting to move inward and inner going outward. Subduction and slab pulls could move down into the core and the core could shift and sink to the more dense ocean surface.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	thermal
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	chemical
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Dense water Mixing of cold bottom water w/ surface water	gravitational
Cold, denser material sinks	Dense water sinks in the North Atlantic Ocean	gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at equator than the poles	thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of water towards the pole	thermal
Oceanic lithosphere slowly cools	Water becomes saltier through evaporation	thermal / chemical

ISP203A – Global Change
Convection in the Asthenosphere and Ocean Circulation

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

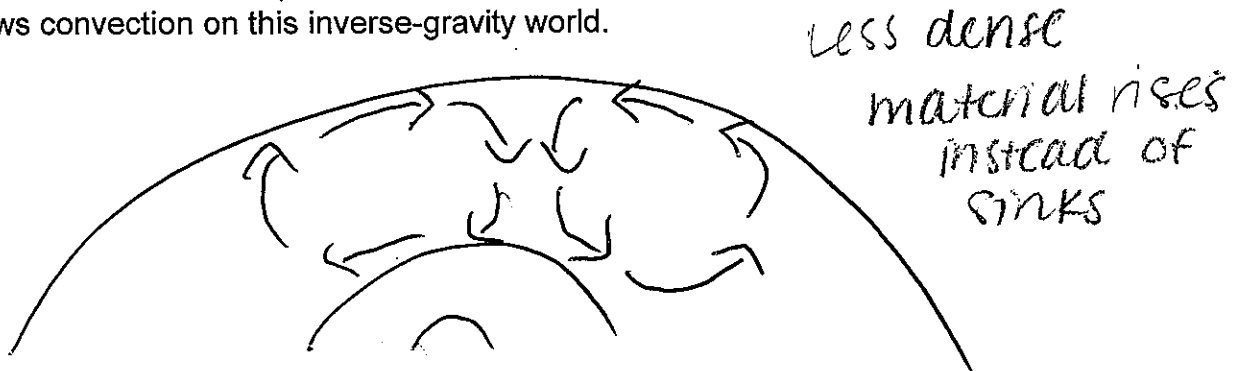
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Energy derived from the core	Energy derived from the sun
Density differences	Temperature & composition drive density differences less dense material rises	Salt & temperature drive density differences less dense material rises

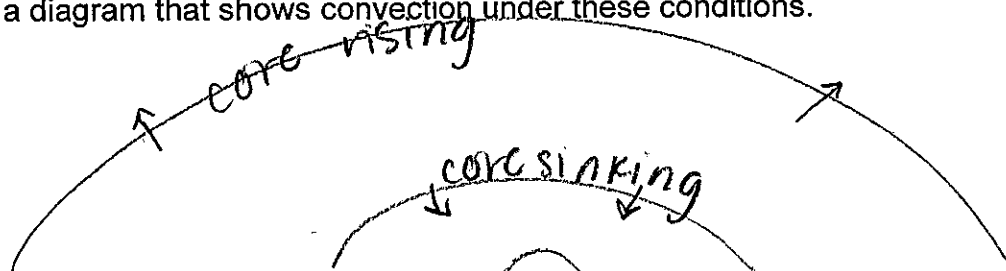
1. Explain why density is such an important concept for asthenosphere convection.

Because less dense material rises and more dense material sinks.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

GROUP #: 27

Student IDs of Members Present:

A40967142, A42669614

A42704999, A42422266

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Chemical
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Denser (saltier) material sinks	Gravitational
Cold, denser material sinks	Cold water sinks	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than the poles	thermal
Sinking lithosphere pulls the plate toward the subduction zone	Dense water sinks in the North Atlantic ocean	Gravitational
Oceanic lithosphere slowly cools	water becomes saltier through evaporation	thermal

ISP203A – Global Change
Convection in the Asthenosphere and Ocean Circulation

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

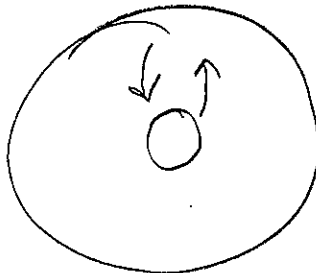
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Gravitational	thermal
Density differences	Temperature/ Composition	Temperature/ Salinity

1. Explain why density is such an important concept for asthenosphere convection.

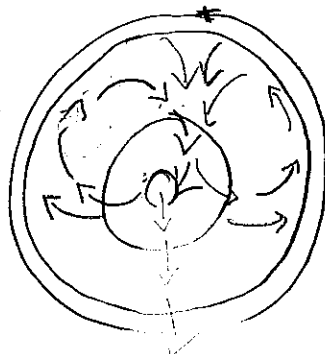
It drives circulation through the compositional and temperature differences.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



Less dense material goes towards the center while more dense would go toward the outside

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	gravitational
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	thermal
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Dense water sinks in the North Atlantic Ocean	gravitational
Cold, denser material sinks	dense water sinks in the North Atlantic Ocean	gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than poles	thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of water toward the poles	gravitational
Oceanic lithosphere slowly cools	Water becomes saltier through evaporation	thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

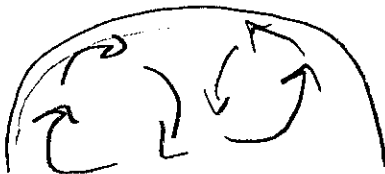
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	heated from the bottom diff. composition	heated from the top diff. composition
Density differences	much more dense	much less dense

1. Explain why density is such an important concept for asthenosphere convection.

Density is important, because it causes the motion circulating in the asthenosphere.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



The more dense material would be at the surface.

3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.



Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	gravitational
Mixing of cold bottom waters with warm surface waters	gravitational
Solar radiation is more intense at the equator than the poles	thermal
Water becomes saltier through evaporation	chemical
Dense water sinks in the North Atlantic Ocean	gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	warmer water sinks denser material rises to top because of gravity	gravitational
Cold, denser material sinks	colder, denser water sinks	gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation provides heat	thermal
Sinking lithosphere pulls the plate toward the subduction zone	wind currents pull water towards poles	gravitational
Oceanic lithosphere slowly cools	top of ocean water is slowly cooling	thermal

ISP203A – Global Change
Convection in the Asthenosphere and Ocean Circulation

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

Table D. Differences Between Asthenosphere and Ocean Circulation

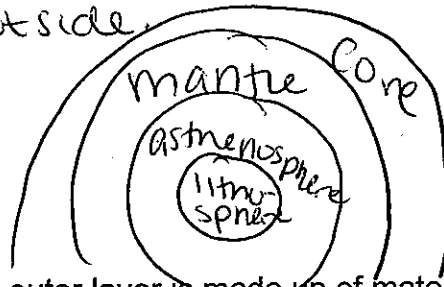
Difference	Asthenosphere	Oceans
Primary source of energy for movement	Thermal energy from within earth's core	Thermal energy from sun
Density differences	composition and pressure	composition and temperature

1. Explain why density is such an important concept for asthenosphere convection.

The composition of the layers has different densities, and without that, the layers would be different.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.

The Earth would be oppositer, with the hardest layer on the outside.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

In time, the layers would be placed in the right order based on their densities. But at first when the layers have different densities, they would be in the wrong place

Part 2: Group Work

Table B. Driving Energy for Ocean Circulation

Ocean Circulation	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Wind-driven currents move masses of water toward the poles	Gravitational
Mixing of cold bottom waters with warm surface waters	Gravitational
Solar radiation is more intense at the equator than the poles	Thermal
Water becomes saltier through evaporation	Thermal
Dense water sinks in the North Atlantic Ocean	Gravitational

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each – use the driving energy as a guide. *Not all aspects of convection in Asthenosphere and Oceans will align.*

Table C. Comparing the Asthenosphere and Ocean Circulation

Asthenosphere	Oceans	Which type of energy (Thermal, Chemical, Gravitational) is driving this process?
Less dense material rises because of gravity	Denser water sinks	Gravitational
Cold, denser material sinks	Dense water sinks in the North Atlantic Ocean	Gravitational
Radioactive decay and residual heat from deep within Earth	Solar radiation is more intense at the equator than the poles	Thermal
Sinking lithosphere pulls the plate toward the subduction zone	Wind-driven currents move masses of water towards the poles	Gravitational
Oceanic lithosphere slowly cools	As ocean water sinks it cools down	Thermal

Consider how these two systems are different. In the table below, fill in the differences between the asthenosphere and oceans.

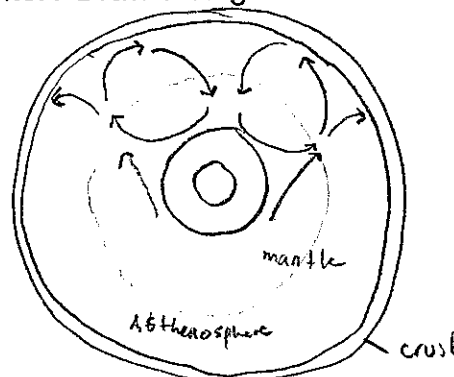
Table D. Differences Between Asthenosphere and Ocean Circulation

Difference	Asthenosphere	Oceans
Primary source of energy for movement	Radioactive Decay	Solar Radiation
Density differences	Less dense material rises because of gravity.	More dense water falls because of gravity.

1. Explain why density is such an important concept for asthenosphere convection.

Density is important to asthenosphere convection because difference in density causes convection as less dense material rises.

2. What would happen to convection in the asthenosphere if gravity pulled material towards Earth's surface, rather than towards Earth's center? Draw a diagram that shows convection on this inverse-gravity world.



3. Imagine that the Earth's outer layer is made up of material that is denser than the Earth's asthenosphere, and that the Earth's core is made up of material that is less dense than Earth's asthenosphere. What would convection look like on this Earth? Draw a diagram that shows convection under these conditions.

